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The ILLUMINATING ENGINEER

ELECTRICITY · ACETYLENE · OIL · GAS

Edited by LEON GASTER

10/6 Yearly. THE JOURNAL OF SCIENTIFIC ILLUMINATION. *1/- a Copy.*

OFFICIAL ORGAN OF THE
Illuminating Engineering Society.
(Founded in London 1909.)

Among other articles this number contains :—

Illuminating Engineering Practice **(a Review of the Course of Lectures delivered at the University of Pennsylvania U.S.A.).**

The Status and Prospects of Gas Lighting **by W. J. Serrill.**

Schoolroom Lighting.

Other matters dealt with include :—

VISIBLE AIR-RAID WARNINGS—PHOSPHORESCENT ZINC SULPHIDE—UNDERSTANDING THE LUMEN—THE LIGHTING OF UNDERGROUND PASSAGES, &c.

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EDITORIAL.

Industrial Reconstruction and the Whitley Report.

In our last issue we referred briefly to the address on the subject of Industrial Reconstruction, given by Mr. E. J. P. Benn to the Circle of Scientific, Technical and Trade Journalists on September 11th. An important Manifesto on the subject, signed by a large number of well-known men of business and university professors, officers of trade associations and the editors of trade and technical journals, has recently been issued.

A summary of the proposals conveyed in this Memorandum is given on page 243. The fundamental principles on which these recommendations are based were set out in the well-known Whitley Report,* namely :—

(*a*) That District Councils, representative of the Trade Unions and of the Employers' Association in the industry, should be created, or developed out of the existing machinery for negotiation in the various trades.

(*b*). That Works Committees, representative of the management and of the workers employed should be instituted in particular works to act in close co-operation with the district and national machinery.

* Interim Report on Joint Standing Industrial Councils, issued by the Reconstruction Committee (Cd. 8606, price 1d., published by H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2, and also obtainable through any bookseller.)

On this basis a more detailed scheme of industrial reconstruction is now built up, each trade to be organised separately under a trade council, and all these councils to be responsible to a new Government Department designed to encourage trade and industry.

It is obvious that the application of such a wide-reaching scheme to each particular industry will have to be very carefully considered. The promoters of the scheme rightly emphasise the desirability of retaining the valuable features of our present individualistic system while adding to them the necessary ordered force to ensure greater activity. It seems evident that in many respects there must be room for latitude—for example, if we take the lighting industry, we can see at once many problems that will need careful study if this industry is to have a Council of its own, entitling members of the industry to a "vocational franchise." We have always contended that there is a common basis for action between different sections of the lighting industry, all of which are concerned with the advancement of illumination in one aspect or another. The platform of the Illuminating Engineering Society has been instrumental in showing how many are the problems in which all these sections are interested. We hope that in course of time illuminating engineering will become a regular profession, and that there will be available a sufficient number of experts in lighting in all its branches to entitle them to a vocational franchise.

At the present time, however, those who make a speciality of lighting in general have also other occupations with which they are professionally identified, and these would have to be considered in determining the vocation in which their franchise would be exercised. It must also be borne in mind that many firms and companies are engaged in various branches of industry, for example, general engineering, besides the supply of lamps and lighting appliances. Gas and electric supply companies, again, are concerned with the supply of these commodities for power and heating as well as for light. It might, therefore, be found preferable to group these interests in a different manner and to provide some form of "cross-connection" to facilitate the treatment of their common ground in connection with lighting.

We are only raising this point to indicate the kind of problems which will necessarily occur in any far-reaching scheme of this kind. In our last issue we referred to the important services which the trade and technical Press can render in promoting discussion on industrial reconstruction; and we conceive that one of their functions will be to raise such debatable points at an early stage in order that they may be threshed out before the moment for decisive action arrives. We should, therefore, welcome the discussion of these debatable points in our correspondence columns. Meantime, there is one principle involved in the scheme which will receive general assent—the need for providing facilities for common action on the part of capital and labour. We are convinced that the industrial future of the country demands much better facilities for an understanding between workers and employers than has prevailed in the past. Joint councils such as those proposed in the Whitley Report are already being formed in some of the most important industries. We feel sure that this intercourse between worker and employer will be productive of good, and that the common ground thus established will not be confined to problems of wages and conditions of employment only, but will include education, research and the interests of each industry as a whole so that members of every grade will have some share in determining its prosperity.

The Report of the Cinema Commission of Enquiry.*

It will be recalled that a paper read by Dr. James Kerr before the Illuminating Engineering Society on February 20th in the present year, on " The Effect on the Eye of Varying Degrees of Brightness and Contrast," referred specially to the problems met with in cinema theatres. In this discussion two representatives of the Cinema Commission of Enquiry, Dr. C. W. Kimmins and Mr. A. E. Newbould, took part and conveyed to the Society an invitation to co-operate with the Commission in regard to questions concerned with lighting.

The writer was subsequently invited to give evidence on this subject before the Commission and accordingly presented a summary of the chief points that required consideration, many of them arising from the discussion referred to above.

The Commission has now concluded its inquiry, and the results are embodied in a comprehensive Report occupying 372 pages. The evidence of forty-two witnesses is reproduced *in extenso* and an exhaustive inquiry is made into the present position and future possibilities of the cinema. Few people realise the extent of the cinema industry, which provides employment for from 80,000 to 100,000 persons in this country, 70,000 feet of film being used every week. It is calculated that the number of attendances at cinematograph entertainments during a single year exceeds a thousand million. It is therefore an obvious necessity for the nature of such entertainments and the conditions under which they take place to be very carefully studied, especially in relation to their effect on the minds and health of children.

A considerable proportion of the evidence is concerned with the moral influence of cinema displays, the conditions of supervision to which they should be subjected, and their educational possibilities. The Commission has done valuable work in collecting evidence on these problems and its recommendation of a State Censorship deserves careful consideration from the authorities. To quote from the Report: " For its own protection, as well as for the ensuring of its continued suitability to the nation, the cinema should have the support and the official countenance of the State. We want to place it in a position of real dignity. We want it to be something more than a trade; in fact we wish it to be one of the assets of our national entertainment and recreation." We may add that the importance of the cinema as a medium for conveying ideas to the public and as an educational force also deserves more recognition. The power of the Press is universally acknowledged, but in the cinema there exists a means of communication equally widespread and possibly only second in effectiveness.

The section of the Report in which we are chiefly interested, however, is that dealing with illumination. In weighing the effect of such entertainments on the minds, physique, and eyesight of children, we must recognise that they essentially convey an appeal to the eye, and that, therefore, the methods by which the lighting, both of the screen and the auditorium, is effected are of great importance. The evidence of the writer and Mr. Bishop Harman deals with many points on which there has been much discussion, such as the order of illumination on the screen, the desirable contrast between this brightness and that of surroundings, the influence of flicker, the desirable duration of entertainments, and the distance and

* " The Cinema: Its Present Position and Future Possibilities " (being the Report and Chief Evidence taken by the Cinema Commission of Enquiry instituted by the National Council of Public Morals, published by Messrs. Williams & Norgate, London, 10s. 6d. net).

angle at which the screen should be viewed. The continuous observation of a brightly illuminated screen amidst relatively dark surroundings is apt to impose a distinct strain on the eyes, and it is common knowledge that the exhibition of unscreened bright lights anywhere within the range of vision of the audience is a cause of mental distraction and visual discomfort. From this standpoint, there is much to be said for the provision of a low general illumination, *free from glare*, while the pictures are being displayed. Lighting and eye-strain form the subject of a special section of the Report, the finding of the Commission under this head being as follows :—

(1) We recommend the adequate illumination of the picture houses whilst the films are being shown.

(2) The best relative illumination of the screen and hall to be determined by a special committee consisting of a few members of the Commission, together with representatives of the Illuminating Engineering Society and technical advisers to the trade. The recommendation of the Hon. Secretary of the Illuminating Engineering Society that the illumination of the hall whilst the display is in progress should be one-tenth of a foot-candle appears to be reasonable.

(3) The continuous display of films extending over some hours is extremely injurious, especially to the young and those with defective eyesight. Hence we recommend that frequent intervals of music, song, or other form of entertainment should be encouraged to relieve the constant strain on the eyes.

(4) We recommend that the front seats should be removed to at least twenty feet from the screen.

On many points involved in the adequate lighting of cinema theatres, such as the avoidance of glare from any unscreened lamps which are particularly distracting to the eye in these circumstances, there is general agreement between experts. It will also be accepted in principle that undue contrasts, either between the screen and surroundings, or the conditions of illumination inside and outside the auditorium should be avoided. The point on which detailed information is chiefly desired is the manner of providing sufficient illumination of the auditorium to prevent excessive contrast with the screen and facilitate supervision by the attendants, without prejudicing the appearance of the pictures. This is a matter which should fall within the province of the joint committee recommended by the Commission, and we feel sure that the Illuminating Engineering Society would gladly co-operate in any investigation that may be undertaken on this point.

As regards the external lighting for cinema theatres, evidence before the Commission advocated that the use of glaring, unshaded powerful lights should be discouraged, in view of the inconvenience of such methods of lighting in the present darkened condition of the streets as well as the desirability of economy in lighting. External lights have since been prohibited by an Order under the Defence of the Realm Act, and it is to be hoped that even after the war these crude and wasteful methods of exterior lighting will be discontinued. The mere display of bright lights cannot be considered judicious advertisement, and attention might be drawn to the theatre much more effectively by the skilful use of screened lights to produce original or artistic effects.

LEON GASTER.

SCHOOLROOM LIGHTING BY GAS.

A PAPER on the lighting of schoolrooms and workplaces, read in February last at the Annual Meeting of the Illuminating Engineering Society in Germany by W. Bertelsmann, presents some features of interest.* The early part of the paper followed fairly familiar lines, but the table presented on p. 236, in which the data has been converted into a form more in accordance with the usage customary in this country, deserves notice.

Dr. Bertelsmann laid due stress on the elimination of glare, the provision of adequate illumination and the value of light tinted surroundings in promoting diffusion. In explaining the calculation of illumination in a room he followed methods on somewhat similar lines to those pursued by Mr. Clinton in his paper before the Society in this country in 1914.† Diagrams were presented showing actual distribution of illumination in rooms as compared with calculated values. These referred to direct lighting, and the agreement between calculated and observed values was in general very close : the additional illumination due to reflection from surroundings being usually within 10 per cent.

In the case of indirect lighting, where so much depends on surroundings, the predetermination of results is not so easy. In the table referred to the author gives some useful figures for direct, semi-indirect, and indirect lighting with gas based on actual installations. It is interesting to note that the values for the specific consumption in cubic feet per lumen on the working plane (*i.e.*, per foot-candle per square foot illuminated) appear to be in close accordance with data presented before the Illuminating Engineering Society in this country. Apparently these are all low-pressure installations. The data bear out the impression that the illumination derived from a given consumption with indirect lighting is not far removed with half that attainable from a good direct lighting installation, while semi-indirect lighting occupies an intermediate position. On the other hand, the diversity coefficient is less than the values recorded with relatively low-suspended units, although apparently not better than the results secured when lamps were mounted near the ceiling. The greatest variation in illumination was recorded for a series of nine shaded low-hanging burners (see *b*, under Direct Lighting), although, as might be expected, this method was efficient so far as specific consumption of gas is concerned, in other cases the higher efficiency secured with relatively powerful units is evident.

In discussing general formulæ for calculating average illumination in a room, Dr. Bertelsmann pointed out that these empirical relations can only be safely employed when the assumptions made regarding type of unit and the shade or reflector are clearly understood. It is of little value to employ a general factor for "shaded" and "unshaded" units, without consideration of the different distributions of light which various reflectors may produce. Similarly, in regard to indirect lighting, one must take into consideration what proportion of the flux of light actually strikes the ceiling, and the presumed reflecting power not only of the latter but also of the walls. The figures given in the table for indirect lighting show the variety in results that may be expected with different installations. It is remarked that the size of the room appears to have a material influence on the results.

Apart from these considerations the author also raises the question whether the mere determination of average illumination is sufficient, especially in schoolrooms. It is little satisfaction to the person occupying the worst-lighted desk to know that the average illumination in the room is up to the standard, if on his own desk the illumination is only a fraction of this average value. In a

* Elektrotechnik und Maschinenbau, May 27th, 1917. Also reported in Elektrotechnische Zeitschrift.

† "A Comparison of estimated and observed values of Illumination in some Lighting Installations," by W. C. Clinton, B.Sc., *Illum. Eng.* (Lond.), Vol. VII., 1914, pp. 189—215.

schoolroom the illumination of the worst-lighted desk should always reach the prescribed minimum value for comfortable work. In planning such an installation for the first time the engineer will, therefore, find it necessary to calculate not only the average value, but the actual illumination throughout the room.

The discussion turned very largely on the merits of direct and indirect lighting. Much of this covered familiar ground, but there were several new suggestions.

Dr. L. Bloch expressed his pleasure in hearing a paper by an expert in gas lighting, in which the principles of illumination were so well explained, and his satisfaction at this instance of the fact that engineers associated with both systems of lighting could co-operate in studying matters of common interest. In regard to indirect lighting he thought that although this system had been widely used with arc lamps, semi-indirect lighting was more suitable for use with half-watt lamps, as it gave a more pleasing effect and yet was instrumental in eliminating

ILLUMINATION DATA FOR DIRECT, SEMI-INDIRECT, AND INDIRECT SYSTEMS.*

Nature of Lighting.	Consumption of gas.	Total mean spherical candle-power.	Mean horizontal illumination.	Specific consumption of gas in cub. ft. lumen (per foot-candle per square foot illuminated) per hour.	Diversity coefficient. Max./Min.
	cub. ft. per hour.		*Foot-candles.*		
DIRECT :—					
(*a*) *Upright Burners*—					
2 high c.p. units without shade	36·2	567	2·6	0·023	1·61
4 Auer burners without shade	18·1	225	1·63	0·018	3·41
(*b*) *Inverted Burners*—					
2 crown-fixtures, clear glass ..	23·5	522	3·3	0·011	3·02
2 crown-fixtures, opal glass ..	23·5	378	2·4	0·016	4·18
9 low-hanging burners with shades	22·0	468	4·45	0·008	5·08
(*c*) *Lights mounted on Ceiling*—					
Clear glass, with shades ..	23·5	522	4·15	0·009	1·99
Opal glass, with shades ..	23·5	378	2·9	0·013	1·83
Clear glass, without shades ..	23·5	522	3·4	0·011	1·67
Opal glass, without shades ..	23·5	378	2·65	0·014	1·72
High C.P. Units on Ceiling—					
Room 41 sq. feet area : Lamps 7½ ft. high ..	15·2	387	6·5	0·007	1·42
Room 185 sq. feet area : Lamps 11¼ ft. high ..	85·0	2269	6·4	0·0075	1·30
SEMI-INDIRECT :—					
Upright Burners	36·2	567	2·73	0·021	2·06
Inverted Burners	23·5	522	2·46	0·015	3·33
INDIRECT :—					
(1) One-Burner Lamp	36·2	567	2·27	0·026	1·72
(2) Two-Burner Lamp	27·5	288	1·42	0·044	2·13
(3) Four-Burner Lamp ..	25·5	342	1·28	0·032	1·88

* In this table the units have been converted from the metric to the British system, and litres to cub. ft. In converting the data on candle-power and illumination the Hefner has been assumed to be equal to 0·9 international candle.

The data presented are thus expressed in the units customary in this country.

the glare that was apt to arise from their high intrinsic brilliancy if they were injudiciously used. It was commonly assumed that in drawing offices indirect lighting was the ideal system, but he was not sure that this was so. In this work strong shadows were objectionable, but there should be some shadow. He had found, for instance, that in striking circles it was convenient to see a shadow from the leg of the compass, otherwise there was some hesitation in locating the centre from which a circle was struck. He agreed with Dr. Bertelsmann that the average illumination was not the only factor to consider in designing an installation; it was, however, a useful general method of comparing the efficiency of different systems of lighting.

Dr. Wedding also preferred semi-indirect to indirect lighting on the ground that the uniform effect of the latter was trying to the eyes.

Dr. Norden remarked that more precise definition was needed in regard to some of the terms used by the author, for example, in the method of referring to diffused or reflected light (*wiederschein*). Similarly, the terms applied to shadows ("Considerable," "Weaker," "Strong," "Softened," etc.) were not sufficiently defined. Shadow conditions should be expressible in numerical terms, and "shadow-testers," *i.e.*, objects of prescribed definitions throwing a shadow capable of investigation, would yield useful information.

Dr. Heyck argued that semi-indirect lighting did not satisfactorily meet the requirement of eliminating inconvenient shadows. There were two methods of gaining this object, either by indirect lighting or by local shaded lights, the position of which could be adjusted so that the light came from the most convenient direction. Semi-indirect lighting, if there was any considerable direct component, did not completely avoid the direct reflection from polished paper of books and magazines. He considered indirect lighting the best system for a room devoted to reading, and it had been installed in the new library recently equipped in Leipsic.

A NOVEL METHOD OF LIGHTING UNDERGROUND PASSAGES.

An account is given in the *Electrical World* of an interesting method of lighting underground passages, applied to a tunnelled passage through the hill on which stands part of the buildings of the National Lamp Works at Cleveland.

In order to remove the impression of gloom that is apt to characterise such passages it was decided to simulate daylight as exactly as possible, thus removing the sense of being underground. Accordingly artificial windows are arranged at intervals along the corridor, lamps being placed in recesses in the walls, with panes of "cynite" glass in front, which diffuse the light with a minimum of absorption. The lamps are of the 100-watt blue-glass daylight type, giving a close approximation to the colour of natural lighting.

A photograph of the passage shows that the effect resembles daylight illumination from windows very closely. The illumination is not even but this is deliberate in order that the shadows may "break up" the passage and cause it to appear shorter.

The main lighting circuits are arranged for either automatic or manual control. On the automatic system there are door-switches at both ends of the corridor so that pushing the door inward turns on the series of thirty-two daylight lamps and operates a time-switch keeping the lights on for four minutes. A person can easily walk the length of the passage in 4—one to one and a half minutes. Should another person enter the passage while the light is already on the time-switch is automatically set back to its initial position. It is found, however, that throughout the greater part of the day the automatic system is practically continuously in operation and it has therefore become customary to keep the lighting on permanently during the busy hours, only applying the automatic system

when the busy hours are over and the passage is little used.

There is also an emergency circuit comprising six 15-watt lamps which are fed continuously from the central station lighting circuit so long as power remains on the lines. Should this power-source fail a relay is provided which would connect the emergency circuit to a storage battery ordinarily used in the laboratory for testing work. There is thus no danger of the passage being left in complete darkness in any event.

PHOSPHORESCENT ZINC SULPHIDE.

The discussion on phosphorescence and fluorescence before the Illuminating Engineering Society last year excited much interest and has led to subsequent correspondence in these columns. It was remarked at the time that information on the chemical conditions responsible for phosphorescence was difficult to obtain, and it is therefore of interest to mention a communication on phosphorescent zinc sulphide which appears in a recent issue of the Journal of the Chemical Society.*

These researches covered widely different methods of preparing zinc sulphide and some interesting results were obtained. In the first place it seems to be recognised that zinc sulphide in the phosphorescent form can only be obtained by the action of heat. Ordinary precipitated zinc sulphide shows no sign of phosphorescence. But by the application of heat, *e.g.*, by deflagrating a mixture of zinc and sulphur, the desired property may be produced. The authors describe various methods of carrying out this process and it is pointed out that the temperature is of considerable importance. Below about 650° C. even prolonged heating produces only a poor phosphorescent effect. Between 650° and 900°, the results are much better, while heating for any length of time above 1100° again produces very poor specimens. The material produced between below 650° was viscous and amorphous, that obtained between 650° and 900° semi-crystalline under the microscope, and that produced at 1100° purely crystalline. It appears therefore that the semi-crystalline state is a desirable condition to produce phosphorescence; the best samples were obtained by heating to some temperature between 650° and 900°. for a time not exceeding an hour and a half. The temperature has also an effect on the nature of the after-glow. Specimens produced at 650° give blue phosphorescence, while higher temperatures lead to greens and even yellows.

The effect of small impurities is also discussed in detail. It is known that some substances, such as iron, are prejudicial, even if present in minute quantity; others, such as sodium chloride, increase the phosphorescent effect. The addition of manganese, again, gives rise to a marked golden yellow phosphorescence, and manganiferous zinc sulphide exhibits strong tribo-luminescence (*i.e.*, production of light on friction).

The authors also state, what we believe is the experience of other observers, that the results obtained by radium stimulation do not in any way concord with those obtained by stimulation with light. One interesting fact mentioned is that the phosphorescence of a prepared sample of zinc sulphide may apparently be much diminished by washing with water. It therefore looks as though some material, soluble in water, was necessary to good phosphorescence, and further evidence on this point is furnished by the fact that the conditions of precipitation have an important bearing on the quality of the product. The suggestion is made that the good phosphorescent effect may be associated with the presence of a skin of zinc chloride over the sulphide, producing a condition of strain. This substance would be washed out by water and its removal might cause the diminution in phosphorescence brought about by washing.

The results in this paper are distinctly interesting. Experiments of the kind indicated should be very useful in enabling us to understand the properties on which phosphorescence depends, and possibly to obtain a much more vivid effect than at present.

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*"Phosphorescent Zinc Sulphide" by Elizabeth MacDougall, A. W. Stewart, and R. Wright, Jour. Chem. Soc., Aug. 1917.

THE STATUS AND PROSPECTS OF GAS LIGHTING.*

By W. J. Serrill.

In this address Mr. Serrill referred in general terms to the work of the Illuminating Engineering Society (U.S.A.), and to the activities of its various Committees, but the greater part of the paper related to the present position of gas lighting. After summarising briefly recent steps in the progress of the industry, he turned to various present problems, prominent among which was the question of producing uniformity in gas supply.

Uniformity in Gas Supply.

Lack of uniformity in the fuel supplied to the consumer is the first obstacle to good gas lighting. It is not essential that one kind of gas should be made throughout the entire country; but when the burners in any one district are adjusted to a particular variety of gas it is highly desirable that the fuel thereafter fed to them should remain constant in quality. In the past two qualities of gas have been general, coal gas and water gas, but in recent years coke oven gas has become an important factor. The differences in these gases in respect of specific gravity, heating power and air-requirements, make the maintenance of a desirable uniformity no easy matter. The chief difficulty, however, has been the effort to maintain a standard candlepower. This quality, now happily in course of abandonment, can only be maintained by varying the proportions of the mixed gases in different seasons, or by processes of enrichment; and it is these changes which cause the variations in the other qualities of the gas essential for incandescent gas lighting.

Calorific instead of Candlepower Values.

Candlepower is of value only as regards gas burned with the open-flame burner. It has no value for incandescent burners and the effort to maintain it is actually detrimental. It is one of the bright spots in the future of gas lighting that this incubus is in process of removal.

However, even on this supposition, the maintenance of uniformity of quality demands constant care on the part of the engineer, and there are apt to arise unforeseen difficulties, such as the present shortage of coal and the inevitable consequent changes in the manufacture of gas, which materially alter quality. One other interesting example of practices which act as an obstacle to the development of incandescent gas lighting is given. In the days of flat-flame burners, it was customary for many gas companies to provide such burners free. It was not found practicable to apply this practice to incandescent gas burners and their accessories; but in many cases companies have still continued to supply free flat-flame burners, while making a charge for incandescent ones. This naturally tended to induce consumers to retain flat-flame lighting, and therefore constituted a great hindrance to progress.

Among the important requirements, reference is made to the necessity for constant pressure. Marked irregularities in pressure are a constant source of dissatisfaction, and the variability permitted in the rules of the Public Services Commissions of the various States are seldom unreasonable. Strictly uniform pressures are only possible on high-pressure systems, with a governor on each service, but there are various devices of recent introduction, which greatly simplify the problem of obtaining constancy on low-pressure systems.

Of equal importance is the removal of impurities from the gas, which is greatly

* Abstract of Presidential Address prepared for the Convention of the Illuminating Engineering Society in the United States: owing to the War the Convention was cancelled, but arrangements have been made for the circularisation of the various contributions prepared.

facilitated by aiming at uniformity of quality of supply. The discolouration of burners and fittings, walls and ceilings, is largely due to the presence of sulphurous impurities, and when such ingredients can be suppressed, relatively little trouble from this source need occur.

Standardisation of Burners and Mantles.

Reference is next made to the question of ignition and distance control, which still offer a fruitful field for invention, and the standardisation of incandescent lighting appliances. At present little has been done in this direction. As yet no company has made a practice of installing standard burners and mantles free, but in time competition may bring them to it. Meantime a number of companies are using all their efforts to prevent the dissemination of inferior burners and mantles, and to encourage storekeepers to purchase reliable types from the company in their district.

Illuminating Engineering and Gas Lighting.

Mr. Serrill emphasises the great value of illuminating engineering to those concerned with gas lighting, In what follows we quote this section of his remarks in full :—

Generally, poor illuminating engineering on the part of the gas company's salesmen may be fairly cited as one of the handicaps to which gas lighting is subjected. Many causes contribute to this. The salesmen are paid by a method which induces them to increase their sales at any cost, or by a method which induces them to select for sale, not the burners which are best for the location, but those which return the best pay to themselves; or campaigns are undertaken in which only one type of burner is offered, or the salesmen are insufficiently instructed in the principles of illuminating engineering and their practices would require a more careful study of the conditions than the salesmen have time for. I am offering no criticism of these causes, as many of them are unavoidable or at times a given practice is advisable in spite of certain objections to it. It may, however, be safely said that these conditions tend to improvement. Salesmen generally are receiving more thorough instruction in illuminating engineering; they are, as a class, better experienced in its practice. One of the National Societies has inaugurated an excellent course of instruction for them in this subject. Gas managers, largely through the influence of our own Society's, are more keenly alive to its importance.

During recent years there has grown up a conviction in the industry that gas companies should inaugurate systems by which their employees should visit consumers' premises to examine and maintain their lighting appliances. Some systems of this nature are in operation at the present time.

Mr. Serrill also points out the importance of effective street-lighting by gas, as bringing prominently before the public the possibilities of this illuminant. Much more, he suggests, might be done towards the ornamental lighting of park-ways, boulevards, and important thoroughfares, and if the demand were thus stimulated there would be many opportunities for special artistic fittings.

In regard to those cases in which the same concern or municipality deals both with gas and electric lighting, he remarks that there is a danger that one of the systems may receive more encouragement than the other. Mr. Serrill strongly emphasises the desirability of both illuminants being afforded chances of development in their proper sphere, and the existence of a sufficient element of competition to stimulate both to make advances.

GERMAN ILLUMINATING ENGINEERING SOCIETY.

Fourth Annual Meeting.

We observe that the fourth annual meeting of the above Society took place on September 15th at the Reichsanstalt in Charlottenburg. The Society has been adopting the method of forming committees on special subjects and a report of the Committee on Practical Lighting Questions was presented by Dr. Lux. Other contributions included papers by Dr. L. Bloch on "Uniform Evaluation or Marking of Sources of Light" and by Dr. Halbertsma on "Diffusion of Light as a means of reducing the Brightness of Artificial Illuminants."

VISIBLE AIR RAID NIGHT WARNINGS.

BY AN ENGINEERING CORRESPONDENT.

THE question of a suitable warning of raids in the daytime having been apparently satisfactorily met by the simultaneous sending up of sound bombs all over London, the more difficult problem of warning at night time is now being discussed.

There can be little question that in the daytime an audible signal, which involuntarily compels attention, is preferable to a visible one which would not reach persons indoors and might even be overlooked by persons outside whose view is obstructed or whose mind is occupied by other matters. Moreover, it is difficult to conceive of a form of visible signal which would attract general attention during the day.

There appears to be difference of opinion as to whether it is desirable to rouse everyone by a sound signal in the night, seeing that most people are under cover. It has been suggested that the signal, if any, should be visible, so as only to directly attract attention of those still in the streets, but a strong demand for an audible form of signal has recently become evident.

Most of the suggestions made relate to the use of searchlights. It has been proposed, for example, that the searchlights should be left going all night and only extinguished when a raid is imminent. People who make this suggestion have evidently no conception of the amount of energy taken by a searchlight, nor of the wear and tear involved in continuous use, besides the fact of furnishing an additional guide to the enemy. An alternative proposal has been that coloured screens should be interposed to colour the beams of a few of the searchlights for a short interval preceding a raid; red would probably be the most appropriate colour. This is a more reasonable suggestion. The same object might perhaps be attained by causing a few of the searchlights to oscillate violently through their complete range of movement across the sky during a short period, or by using flashing shutters or other devices to give an intermittent "winking light. Yet another proposal is that red flares or rockets, instead of sound bombs, should be sent up.

One difficulty that is not generally recognised by the public is the high luminosity of the sky in full moonlight, when aeroplane raids are most probable, other conditions being favourable. The brightness of some parts of the sky is of the same order as that of a white surface illuminated by full moonlight, in certain atmospheric conditions may even exceed it. In these circumstances the beams of searchlights, are not very noticeable, and even coloured flares, unless very numerous and powerful, might not be easily visible from a sufficiently extensive area—so as to give a general warning.

If recourse is had to local warning devices, *i.e.*, constables on cycles carrying "Take Cover" notices, the question of the illumination of such notices by portable lamps, and the erection of luminous signs capable of being switched on at any moment is worth considera-

tion. A method which, it is understood, is receiving attention is the use of illuminated motor cars, and omnibuses, carrying the words "Take Cover" or "All Clear" as the case may be, to patrol the main thoroughfares.

According to the *Evening Standard*, Bermondsey is adopting measures of its own for dealing with the problem. It is stated that small blue-colour electric lamps are to be displayed on the tops of the flagstaffs at the Bermondsey and Rotherhithe Town Halls, so long as all is clear and no warning of a raid has been received.

On the receipt of a warning the blue lamps will be cut off and red lamps lighted instead, until the "All Clear" notice is received. Should a raid take place in the day-time a red flag with the words "All Clear" on it will be shown at the two town halls as soon as the official notice is received that danger is past.

Assuming that the exhibition of lights at night is considered dangerous by the authorities, one would imagine that objection might be taken to local expedients in the form of coloured lamps on public buildings. This objection would be greatly diminished if all the rays of light were screened above the horizontal, but the method obviously requires supervision and a uniform procedure should be adopted in different localities. One may question, however, whether this form of warning would be visible over a sufficiently large area to be worth while, unless the lamps were exceptionally bright.

With regard to the exhibition of a red flag in the daytime it seems a pity to depart from the customary association of the colour red with danger; the red flag would be more appropriate as a warning, and another colour (yellow, say) to indicate "All Clear." Another objection to the device is that it is usually difficult to read letters on a flag at any distance; especially when the flag is drooping on a calm day with little wind—such as would be probable in the event of a raid.

Appropriate notices, indicating places where shelter could be obtained during a raid also deserves consideration. Black letters on a yellow ground would answer this requirement as well as being easily visible from a distance.

In order to render the notices conspicuous by night artificial illumination, by sources completely screened from the eye, might be provided—at all events outside all buildings where gas and electricity are available.

LIGHTING ECONOMIES IN BERLIN.

According to Reuter the Berlin authorities have published a statement that the dearth of coal makes it indispensable to stop lighting the steps of halls, a proposal which is open to criticism on the ground of interfering with safety, and which would, presumably, have a very small influence on coal consumption. Houses in Berlin, it is also stated, are to reduce the lighting to a minimum where lighting is indispensable.

FACTORY LIGHTING AND OUTPUT.

In an article in the *Electrical Review and Western Electrician*, Mr. J. J. Kirk quotes an instance of a factory, namely, that of Horn Brothers' Manufacturing Co., in Chicago, in which improved illumination has had a marked effect on output.

The original lighting system was inadequate for the demand for increased production, and the spoilage, especially during the latter part of the day, became excessive.

Mr. W. F. Horn, in referring to the satisfactory nature of the new installation, states that production has been increased by 10 per cent., and spoilage has been completely eliminated. All this he considers to be due to the better artificial lighting of the plant.

INDUSTRIAL RECONSTRUCTION.

AN important Manifesto on industrial reconstruction has just been issued bearing the signatures of more than 40 well-known business men, university professors and engineers, a still larger number of officers of representative Trade Associations, and the Editors of a variety of technical journals.

The first essential in any scheme for the fuller development of industry is the co-operation of labour, and the Manifesto accordingly invites the workers cordially to join with the management in the self-government of industry and gives them an equal status and responsibility on the controlling body.

The promoters of the movement attach much importance to the support of the trade Press. Close upon seventy powerful trade and technical journals have signified their general approval of the scheme and their influence on manufacturers and traders will naturally be great.

It is stated that a meeting is to be arranged shortly for the further explanation of these proposals. In the meantime all inquiries on the subject should be addressed to the Secretary Mr. F. H. Galton, Benn Bros. Ltd., 8, Bouverie Street E.C.

With a view to increasing national output and developing industries the following steps are regarded as necessary :—

(1) The mobilisation of each industry for common action.

(2) A greater degree of co-operation between manufacturers.

(3) Co-operation between Labour and Capital and the avoidance of industrial strife.

(4) A more complete association between scientific institutions and traders.

(5) Education better adapted to commercial needs.

(6) Each industry to be studied as a whole and freed from unnecessary internal competition.

(7) Every trade to present a united front to foreign competition.

(8) Output regarded as a duty by both capital and labour.

(9) Encouragement by the Government of the activities of traders with a minimum of interference.

It is therefore suggested :—

(A) That a National Organisation, on lines suggested by the Whitley Report should be established which will retain all the sterling qualities of our present individualistic system and add to them the necessary ordered force to ensure greater activity.

(B) That such an organisation will need to provide for the representation of all classes of persons engaged in a given industry.

(C) That industry should, therefore, be enfranchised and every man and woman, employer and employed, given a vocational or trade vote by means of which this representation would be effectively realised.

(D) That every citizen should have the right to register with some approved Trade Association or Trade Union, and thus an Industrial or Vocational Register properly classified would be produced.

(E) That Trade Councils should be elected in each industry from the Trade Associations and the Trade Unions, Such Councils, elected upon a truly representative basis, would be able to speak in the names of the whole of their respective industries.

(F) That all questions as between Government and a given trade should be delegated to the Council of the Trade, who would have powers to deal with them.

(G) That questions of output, education, trade schools, scientific research, export, wages, profits, markets, tariffs, etc., should be settled in each trade by the Council of that trade, and national funds spent upon these matters dispensed through the Trade Councils.

Finally the Manifesto puts forward a scheme of industrial reconstruction embodying the above features. A vocational franchise would make possible the organisation of each trade separately under a Trade Council composed of capital and labour. A Government Department should be established to promote and encourage trade, and to create representative Trade Councils in every trade, and should be assisted by an Advisory Council consisting of the Chairmen of all the Trade Councils. Such a scheme would permit the decentralisation of a large proportion of the national work now attempted by Government Departments.

THE ORGANISATION OF ENGINEERING TRAINING.

AT a gathering of representatives of the Press at the Institute of Journalists on Sept. 27th, a preliminary account was given of some proposals for the better organisation of engineering training. Mr. L. Gaster, Chairman of the Circle of Scientific and Technical and Trade Journalists, presided.

The meeting was addressed by Mr. A. E. Berriman, Chief Engineer of the Daimler Co., Ltd., Coventry, and Mr. A. P. M. Fleming, of the British Westinghouse Electric and Manufacturing Co., Ltd. (Manchester), the honorary organisers of a meeting called to discuss this subject at the Institution of Civil Engineers on Oct. 25th.

Mr. Berriman explained that while some of the leading engineering firms were arranging adequate courses of instruction for their employees, there were cases in which the conditions of apprenticeship were not satisfactory; what was needed was some general supervision for ensuring that all engineering workers were properly trained. This matter was of urgent importance if the national supremacy in engineering industries was to be maintained. At the forthcoming meeting the question of establishing a central organisation for improvement in and better co-ordination of engineering training would be discussed and a proposal made for the appointment of a representative committee of engineering and educational interests to initiate action. At present no actual scheme exists but the need is recognised by leading manufacturers. Educationists have also expressed themselves in cordial agreement with the idea in principle.

It is greatly to be hoped that the forthcoming meeting will result in definite action being taken. Meantime the honorary organisers have taken a judicious step in bringing the matter before the notice of the Press, which is in a position to render very effective aid in making this matter widely known.

CORRESPONDENCE.

CO-OPERATION BETWEEN THE BRITISH GOVERNMENT AND THE TECHNICAL PRESS.

SIR,

Though we are far from desiring to see the British Government everywhere adopting or imitating the innovations of allied or other Governments, we think the Premier might well take a leaf out of the book of Governor Whitman, of New York State. The Governor recently met in conference the editors of the various technical journals in the State, desiring to get reliable evidence upon questions of mechanical production, transport, coal and timber conservation, the provision of machinists and toolmakers, and other vital factors essential to the successful prosecution of the war. As a result, the Governor has now a Committee of five editors acting in an advisory capacity.

Perhaps no class in the community has its fingers more completely upon the pulse of British industries than the men who so worthily and efficiently edit our Technical Press, and we feel sure they might with advantage be called in to the State councils where accurate information is above all things essential. At such a time as this, when, to take only three important branches of public service, the Air, Agricultural, and Marine Departments, there is urgent need for the wisest and sanest counsels as well as driving forces, we think nothing but good could come by the introduction of editorial assistance.

Yours, etc.,

C. W. BRETT,

Managing Director and General Manager,
Barimar, Ltd.

REVIEWS OF BOOKS.

ILLUMINATING ENGINEERING PRACTICE.

A series of twenty-two lectures, arranged by the Council of the Illuminating Engineering Society (U.S.A.) and delivered at the University of Pennsylvania, September 20th—28th, 1916; published in volume form by the McGraw Publishing Co. (New York), and available from the Hill Publishing Co., Ltd. (6-8, Bouverie Street, London, E.C.). [578 pp.; 5 dollars.]

It will be recalled that in the autumn of 1910 a course of lectures was arranged, under the auspices of the American Illuminating Engineering Society, by the Johns Hopkins University (Baltimore). This course dealt mainly with fundamental principles. The series of lectures now issued is supplementary to the Johns Hopkins course, and contains a great deal of information on present practice in illuminating engineering, which has become much clearer and more definite during the six years intervening between the two courses of lectures.

We observe that the lectures were well attended, 180 full course subscriptions and 59 tickets to individual lectures being taken. The lectures were supplemented by an exhibit illustrating modern methods of illumination (of which a short illustrated description is given), and visits to various localities of interest to lighting experts.

In what follows we propose to give a brief summary of the contents of these 578 pages. The matter in the volume is arranged in orderly sequence, and there are many diagrams and illustrations. Some of the line diagrams, especially those applying to electric lamps, are excellent, and Mr. Ryan's lecture is illustrated by a number of the familiar colour-plates showing the decorative lighting at the Panama-Pacific Exhibition. The text is presented on paper without shine, and the illustrations on mat art paper—a good arrangement that has been widely adopted in connection with the publications of the American Illuminating Engineering Society. Some of the illustrations of models on a small scale displayed at the exhibit accompanying the lectures are also of interest; notably one contributed by the Electrical Testing Laboratories to show the characteristic features of street lighting.

At the conclusion of the volume there is an adequate index, and at the conclusion of some of the lectures are useful series of references to the literature of the subject dealt with.

We will now attempt to give some idea of the contents of the volume, although it is naturally impossible to do more than give a brief sketch of this

large amount of matter in the space available.

Illumination Units and Calculations.

The first lecture by Mr. A. S. McAllister deals appropriately mainly with units and symbols, the series of definitions framed by the Illuminating Engineering Society in the United States being reproduced. In the explanatory matter special reference is made to calculations of natural illumination from the sky, a subject which lends itself well to illustrating the conception of brightness. The distribution of light from illuminants, and the use of the polar curve, and the Rousseau diagrams enabling the flux of light and the mean spherical candlepower to be determined are explained, and there are some general remarks on calculations—a subject which is also treated in subsequent lectures. In order to illustrate the part played by reflection from surroundings a calculation is given for a room of specified size, the flux of light impinging on walls and ceiling being determined and the utilisation factor (*i.e.*, the percentage of the total light falling on the working plane) deduced.

Interior Illumination.

The second lecture by Messrs. J. R. Cravath, Ward Harrison and R. ff. Pierce deals with interior illumination, and follows naturally after the preceding one. A table is given for the output of standard American tungsten lamps, and we are reproducing this as illustrating how such lamps are now being rated in lumens. The output in lumens by cub. ft. per hour or per gallon respectively for various other illuminants, oil, gas, acetylene, etc., are also given. We notice that modern gas lamps with outputs of 400—3,000 lumens (say 32—240 m. sph. c.p.) are stated to yield 200—325 lumens per cub. ft. per hour. Presumably this refers to low-pressure units. A third useful table gives the conversion figures when brightness is expressed in various ways (c.p. per sq. inch, equivalent foot-candles, millilamberts, etc.). This should be useful, as the latest methods of expressing brightness are not yet very widely known.

Reference is also made to the effect of deposits of dust in causing deterioration in illumination, and curves are presented showing that, as a result of one month's neglect, a loss in light of 15—30 per cent.

Table I.—Lumens Output of American Tungsten Incandescent Lamps (July 1st, 1916), operated to give an average rated life of 1,000 hrs. (J. R. Cravath, Ward Harrison and R. ff. Pierce).

Watts.	Watts per mean sph. c.p.	Lumens per watt.	Total lumens.
	105–125 volt Mazda B Lamps.		
10	1·67	7·5	75
15	1·47	8·55	128
20	1·41	8·90	178
25	1·35	9·30	234
40	1·32	9·50	380
50	1·31	9·60	480
60	1·28	9·80	590
100	1·22	10·3	1,030
	105–125 volt Mazda C * Lamps.		
75	1·09	11·5	865
100	1·00	12·6	1,260
200	0·90	14·0	2,800
300	0·82	15·3	4,600
400	0·82	15·3	6,150
500	0·78	16·1	8,050
250	0·74	17·0	12,800
1000	0·70	18·0	18,000

* Gas-filled. N.B.—220 volt lamps are about 10 % less efficient

may be experienced, according to the type of the reflector. Next there is a summary of the chief varieties of glare (from exposed sources, reflection from shiny materials, etc.), and the view is expressed that the contrast between the brightness of objects in the field of view should not exceed 100 : 1. A table is presented summarising the amount of illumination required for various processes and some general remarks are made on the procedure to be adopted in designing the illumination of an interior.

Turning next to flood-lighting Dr. Bell suggests the formula $E = \frac{4\pi\omega\eta}{\pi\gamma^2} = \frac{4\omega\eta}{\gamma^2}$ for determining the illumination in foot-candles derived on a surface illuminated by a beam. If the section of the beam is elliptical the formula $E = \frac{4\omega\eta}{ab}$ may be substituted. In these formulæ :—

η = the specific efficiency of the source, *in its reflecting system*, $= \sigma\rho\kappa$.

TABLE II.—CONVERSION TABLE FOR BRIGHTNESS VALUES.

Values in units in this column multiplied by conversion factor equal values in units at top of column.	Candles per sq. cm.	Candles per sq. in.	Candles per sq. metre.	Candles per sq. ft.	Lamberts, apparent lumens per sq. cm.	Foot-candles, apparent lumens per sq. ft.	Milli-lamberts.
Candles per sq. cm. ..	1	6·451	10000	929·03	3·14	2918	3141·6
Candles per sq. inch ..	0·155	1	1550	144	0·4867	452	486·7
Candles per sq. metre	0·0001	0·00064	1	0·929	0·00031	0·292	0·314
Candles per sq. foot ..	0·00108	0·0069	10·7	1	0·000339	3·14	3·391
Lamberts (apparent lumens per sq. cm.)	0·318	2·054	3180	295·8	1	929·03	1000
Foot-candles (apparent lumens per sq. ft. ..	0·000343	0·00214	3·40	0·318	0·00108	1	1·076
Millilamberts	0·000318	0·002054	3·180	0·2958	0·001	0·929	1

EXTERIOR ILLUMINATION.

The principles of exterior illumination are dealt with in a similar manner by Dr. Louis Bell, who classifies streets according to the chief purpose to be served, and suggests appropriate minimum illumination values. These are substantially similar to those suggested in the Standard Specification for Street-lighting drawn up in this country. Dr. Bell is inclined to prefer single units to clusters, chiefly on account of the greater attention the latter require. Powerful units of the order of 1,000 c.p. should not be placed lower than 25 ft., and 30 ft. is suggested for large squares. Such units should be equipped with diffusing globes. Lighting units of more moderate candle-power, 100—300 c.p., in many cases also require screening, and are usually placed at a height of 15—20 ft. Lamps of smaller output than 100 c.p. do not in general require screening. As regards the diversity factor a variation in illumination of 1 : 10 can only be attained with special efforts and values ranging from 1 : 25 or even 1 : 50 may occur in an apparently well-lighted street.

ω = watts consumed.

σ = specific output of source in spherical candles per watt.

ρ = coefficient of reflection of the mirror surface.

κ = percentage of total sphere effective, *i.e.*, the percentage of the total flux from the source which impinges on the mirror.

Finally there are some remarks on the use of coloured light for decorative purposes, as exemplified by the San Francisco Exhibition.

MODERN PHOTOMETRY.

The next lecture by Dr. C. H. Sharp on Modern Photometry contains a general survey of recent work on the flicker photometer, Crova's method, and physical photometers. The position of flame standards such as the Pentane lamp is illustrated by appropriate diagrams, and a form of portable electric standard, which seems to meet a distinct need for reference work, is described. A considerable amount of attention is given to the Ulbricht sphere which appears to

be now systematically used for obtaining the flux of light in lumens from incandescent lamps by, among others, at least two laboratories, the Bureau of Standards and the National Lamp Works of the General Electric Co., U.S.A. Special arrangements have been made to facilitate the rapid interchange and testing of such lamps, and, in view of the recognition of rating in lumens, the method is worth notice. The Sharp and Millar illumination photometer is described and also various adjuncts, such as the compensated test-plate designed to give consistent results independent of the angle of incidence of the light.

Another special section of photometry covered is daylight measurements and determination of brightness. A double photometer is shown enabling measurements to be made simultaneously of the general unrestricted daylight illumination, and the illumination actually obtained at a given spot; from this the "daylight factor" is readily determined. Other special points are the photometry of gas-filled lamps, measurements of reflection and transmission, and tests of projection apparatus. The lecturer took the view that searchlights (involving merely a source and a parabolic mirror) can be treated on the assumption that inverse square law holds at reasonable distances; but this may not apply to an automobile headlight where we have also a lens, where an image of the filament is often produced, and where tests must often be made at relatively short distances away.

Lamps and Lighting Appliances.

There is next a group of three lectures by G. H. Stickney, R. ff. Pierce, and W. F. Little respectively, on "Recent Developments in Electric Lamps," "Recent Developments in Gaslighting," and "Modern Lighting Accessories."

The data on electric lamps are very well assembled and illustrated. Illustrations of a typical series of gas-filled lamps are shown, and the lecturer explained by the aid of diagrams the chief improvements in design since 1910, namely, (A) drawn tungsten filaments, (B) coiled filaments, (C) concentrated filaments, (D) chemical "getters," and (E) gas-filled construction. Other electric illuminants, such as arc lamps and mercury vapour lamps, are treated in detail, the method of showing the polar curve of each along with a diagram of the lamp being very effective. There is a detailed schedule of tests on arc lamps, comprising efficiency, life of carbons, &c.

Mr. Pierce shows by microphotographs the difference in structure of cotton, ramie, and artificial silk mantles, and illustrates diagrammatically the relation between the percentage of ceria and the candlepower for old and new mantles. Burner-design is dealt with in a general manner, and some attention is given to distance control and electromagnetic valves. Some typical semi-indirect gas fittings are shown.

Mr. Little discusses fully the materials used in globes and reflectors, and the properties of various kinds of glass. A table is presented showing the percentage of light reflected, transmitted, and absorbed by a variety of glasses with the ray incident at 20°. Similar data are given for the reflection of polished metals and other surfaces (*e.g.*, corrugated mirror, 80 per cent.; polished aluminium, 67 per cent.; mat porcelain enamel, 73—79 per cent.). One interesting point mentioned is that gelatine, though apparently colourless and transparent, is appreciably more absorbent to the blue end of the spectrum than is clear glass. The chief elements in reflector design are discussed, and polar curves, showing the distribution of light from a variety of types, presented.

Light Projection.

The last lecture we shall refer to on this occasion is that by E. J. Edwards and H. H. Magdsick, on "Light Projection." Curves obtained from typical headlights are given, and a couple of tables are made out summarising the regulations of different States for automobile and locomotive headlights respectively. The former stipulate, as a rule, the range of the beam (usually 200 feet), while the latter require a certain candlepower, usually about 1,500. There is also a brief discussion of the searchlight proper and of lens-signals and lighthouse equipment, and a number of examples are given illustrating the use of flood-lighting to illuminate monuments and public buildings. Finally, there is an interesting analysis of the loss of light in a typical cinematograph projection apparatus; in one example given, only 775 lumens reach the screen out of 23,600 generated by the lantern (approx. 3 per cent.).

(To be continued.)

Trade Fallacies, by Arthur Kitson. P. S. King and Son, Ltd., London. 1917. *pp.* 286.

IN this work Mr. Kitson deals with a very complex subject, on which there have been very divergent opinions expressed by economists from time to time. He is of the opinion that the legal tender and Bank Charter Acts have had undesirable consequences, and that the conception of credit as based on a gold reserve is a mistaken one. It was not infrequently assumed before the war that a nation which lost all its gold supply would inevitably go bankrupt. It would be as absurd, Mr. Kitson suggests, to argue that if there should be a famine in paper, and it therefore became impracticable to print railway tickets, all the railways of the country would have to cease operations. Gold is only a token, and in times of war its place can be taken by paper currency to a very great extent; in fact Mr. Kitson suggests that so far as home trade is concerned paper is all that is necessary. In times of national emergency nations invariably cease to depend on a gold reserve; their ultimate reserve is the national production.

The author also draws a distinction between British and German systems of banking. The former, he says, is based rather on finance and usury, the latter on production. The British system, while having financial advantages, has industrial drawbacks. To some people it will come as a shock to find that Mr. Kitson does not seem to see any great drawback to the multiplication of paper currency. The creation of paper notes in vast numbers is, he thinks, at least preferable to floating large loans.

Mr. Kitson's book, which is presented in very readable style, certainly provides food for thought, and may lead many people to review their present views on economics and finance.

Illuminating Engineering Society (U.S.A.) Transactions Vol. XII., No. 5, July 20th, 1917.

THE copy of the above *Transactions* last received contains two interesting communications on "Gas and Electric Lighting of the General Offices of the Consolidated Gas Co.," by T. Schofield and C. L. Law, and on "Maintenance of Residence Gas Lamps," by H. H. Newman.

There are also several announcements of interest in the "News Items," including the list of members of the National Committee on Gas and Electric Service, which has been formed to co-operate with the Government in the conduct of the war. On this committee sixteen gentlemen prominently connected with the leading gas and electrical undertakings in the United States are taking part, and it is gratifying to note this fusion of gas and electric interests in the national interest. This body will act as an Advisory Committee to the Council of National Defence.

Among other features of interest in the number are a brief history of the aims and work of the Society and the "Illumination Index," which contains a list of the chief current papers and articles dealing with lighting and illumination.

There is also a review of the activities of the various committees working under the Society, including one dealing with Safety Limitations. This Committee is apparently dealing with matters relating to illumination and traffic. In view of the keen interest being taken in such questions in this country its deliberations will be watched with interest.

We note that Mr. G. H. Stickney will follow Mr. Serrell as President of the Society, and will take up his duties at the commencement of the new session on October 1st.

General Electric Review (August, 1917).

THIS issue contains a variety of articles dealing with widely different aspects of electric technology, such as the Pliotron oscillator, Charging Storage Batteries for Electric Vehicles, and the Comparative Costs of Developing Power for Pumping in the Oilfields. We also notice general contributions by E. W. Rice on, and H. W. Buck dealing with, the position of the engineer in national affairs, and in the prosecution of the war, while the fuel problem is the subject of editorial comment. An article by M. Luckiesh on the Colouration of Arc Lamp Globes was noticed in our last issue. The front of the cover carried an effective illustration, showing the use of flood-lighting in guarding the Queensborough Bridge, New York City.

"UNDERSTANDING THE LUMEN."

WE have received from the British Thomson-Houston Co., Ltd., a note, under the above title, in which an analogy is drawn between the behaviour of a pump sending out so many gallons of water per minute and a source of light emitting a certain, unevenly distributed flux of light. In view of the interest now being taken in the method of rating lamps in lumens, we are reproducing this explanation, which is as follows :—

The term "lumen" is becoming more familiar to all branches of the electrical trade, and is now in use by the leading manufacturers of Great Britain as the rating for expressing the luminous output of a lamp in place of candlepower.

A lamp may be regarded as a pump, which uses electricity to pump light out from it in so many different directions that the numerous streams (or beams) form a solid "flood" or "flux" of light. Some of the beams, however, are pumped out with a greater force than others, which causes the lamp to give a stronger light in some directions and no light at all in others. The force or strength of the beams in any one direction may be taken to represent the candlepower in that direction. It is manifest, therefore, that this candlepower (expressing the one-direction force of beam) cannot be a really accurate full measure of the amount of light that is being pumped out by a lamp in all directions.

With the old method of rating lamps, by expressing the light value in candlepower, we simply stated the average force of all the beams pumped out from the lamp in one direction, *i.e.*, the horizontal direction (with the lamp hung tip down). No consideration was given to the light pumped out in other directions. One might have two lamps of the same candlepower, one of which gave little or no light in other directions than the horizontal, while the candlepower of the second lamp was a minimum in the horizontal direction. Inasmuch as lamp filaments are now being made in numerous complicated shapes and forms, each form producing different distributions of light; and still further, as few lamps are now being used except with shades or reflectors which modify the distribution of light still more—realising all this, some other rating than a mere one-direction intensity is necessary properly to express the actual light output given by a lamp.

For these reasons the lumen has been adopted, as it expresses in an accurate way the value of the total light flow from the lamp just as a unit of water pumped is expressed accurately by the gallon flow per minute. We can say, "This lamp generates 600 lumens," just as we would say, "This pump delivers 600 gallons per minute." As some pumps require more power than others to make a given delivery of water, so some lamps require more energy (watts) than others to generate the same number of lumens of light. Here we have an expression for the efficiency of a lamp, *i.e.*, "lumens per watt." Neither the lamp rating in lumens nor the "lumens per watt" efficiency can be altered by any change in the shape of the filament or the use of reflectors, or other change in the distribution of the light. The lumen values remain the same, and always express the actual total light flow from the lamp. The "lumen" is a better unit than "mean spherical candlepower," as "mean spherical candlepower" is only an imaginary quantity, and its determination or calculation is a very tedious process. When you have the mean spherical candlepower you cannot apply it in a useful way as you can the lumen. The lumen immediately enables one to determine the degree of illumination given by a lamp. By its definition the lumen "is the amount of light which will illuminate 1 sq. ft. of surface to the intensity of 1 ft. candle." Therefore, knowing the number of lumens, we immediately know the degree of illumination in foot candles on the surface illuminated.

The lumen has been adopted by the engineering societies and lamp manufacturers of the United States and Canada, and with its adoption by the leading British lamp manufacturers its use is becoming more and more widespread throughout the world.

ROTARY CONVERTERS.

A well-illustrated booklet dealing with rotary converters has been issued by Messrs. Siemens Bros. Dynamo Works, Ltd. There is a useful comparison between rotary converter, motor-converter and motor-generator, and the section dealing with the control of voltage on rotary converters deserves special mention. An appendix contains a full list of particulars required for the preparation of a tender for plant of this description.

TOPICAL AND INDUSTRIAL SECTION.

[At the request of many of our readers we have extended the space devoted to this Section, and are open to receive for publication particulars of interesting installations, new developments in lamps, fixtures, and all kinds of apparatus connected with illumination.

The contents of these pages, in which is included information supplied by the makers, will, it is hoped, serve as a guide to recent commercial developments, and we welcome the receipt of all *bona-fide* information relating thereto.]

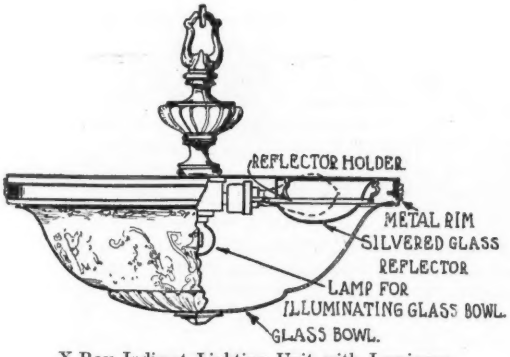
INDIRECT LIGHTING WITH TRANSLUCENT GLASSWARE.

THE accompanying illustrations sent us by the National X-Ray Reflector Company of Chicago refer to two examples of an ingenious modification in indirect lighting units.

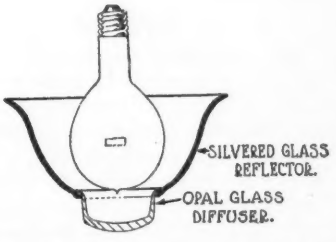
It has sometimes been objected that the opaque bowl, seen immediately under a brightly lit ceiling, is a drawback to indirect lighting, although this effect can be largely mitigated by the use of a pleasing moulded white exterior for the bowl.

In the units shown above a different method of meeting this point is adopted. In both cases the fitting is so designed that while the mirror-glass reflector is used to direct the bulk of the light upward, a small amount is allowed to illuminate a translucent covering bowl, or diffuser at the base of the unit. In this way an effect similiar to semi-indirect lighting is produced but at the same time the essential qualities of indirect lighting are preserved.

We may add that the British Thomson-Houston Co., Ltd., are British agents for these and other X-ray lighting appliances.



X-Ray Indirect Lighting Unit with Luminous Glass Bowl.



A smaller X-Ray Indirect Lighting Unit, also showing the Combination, with a Mirror-glass Reflector and a Luminous Glass Diffuser at the base of the Unit.

THE "METROFLAM" ARC LAMP.

A list recently issued by Messrs. Johnson and Phillips, Ltd., describes the "Metroflam" non-interval magazine flame arc lamp.

Such lamps are stated to give 4000 candles for 500 watts, 3300 candles for 440 watts and 2100 candles for 350 watts, and are recommended for lighting large industrial areas.

IRON AND STEEL INSTITUTE.

At the autumn meeting of the Iron and Steel Institute on September 20th—21st, a number of important and interesting papers were presented.

Among these may be mentioned a comprehensive treatise on "The Eggertz Test for Combined Carbon in Steel," by J. H. Whitely, while Dr. E. B. Wolff discussed in some detail "Failures in Boiler Plates and Stresses in Riveted Joints."

Several investigations related to the heat-treatment of iron and acid open-hearth processes, the briqueting of iron ores, and experiments on shock-tests for the determination of resilience. Other communications dealt with refinements in apparatus for measuring and controlling high temperatures.

PHOTOMICROGRAPHS IN COLOUR.

Lantern slides representing photomicrographs of sections should, in order to give satisfaction, closely resemble the appearance of the section itself. In a note in the *Journal of the Franklin Institute* for August Dr. Kenneth Mees explains that this object can be obtained by making the print in stained gelatine instead of by the usual photographic process. The method of printing is described in detail, and it is stated that the filters required can be selected from the special series of Wratten M filters now available. The photographed negatives are made through these suitable colour filters, and are then dyed in two stains and placed face to face so that a two-colour slide can be obtained.

PERSONAL.

We understand that, on reaching the age-limit this month, Sir Arthur Whitelegge, K.C.B., who has held the position of H.M. Chief Inspector of Factories and Workshops at the Home Office for more than 21 years, retires. During his tenure of office Sir Arthur Whitelegge took a great interest in matters of hygiene, and it was largely owing to his sympathy with the claims of better lighting in factories that the matter was taken up so fully by the Home Office Factory Dept. As a member of the Home Office Departmental Committee on Lighting in Factories and in Workshops, appointed in 1913, Sir Arthur did much to promote the study of this subject.

The Home Secretary has appointed Mr. H. M. Robinson, the Senior Deputy Chief Inspector, as his successor. We are glad to note that Sir Arthur will continue to give his services to the Factory Department in an advisory capacity.

Assets exceed £2,500 000.

Claims paid over £8,500,000.

By Appointment.

GENERAL

Accident Fire and Life

ASSURANCE CORPORATION, Ltd.

General Buildings, Perth, Scotland.
General Buildings, Aldwych, London.

Established 1885.

WAR ECONOMY.

In consequence of the War, the cost of building material and labour has increased nearly 50 per cent. All owners of property should therefore increase their Fire Insurances; this they can do at little or no extra cost by taking a Fire Bonus Policy with this Corporation, and thus effect a saving of 20 per cent. of each premium.

Particulars on receipt of post card at either of the above Offices.

F. NORIE-MILLER, J.P.
General Manager.

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COUPON INSURANCE TICKET

Applicable only within the United Kingdom.

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To whom Notice of Claims under the following conditions must be sent within seven days of accident

£250 TWO HUNDRED AND FIFTY POUNDS will be paid by the above Corporation to the legal personal representatives of any person who is killed by an accident causing material damage to the passenger train in which the deceased was travelling as a ticket bearing or paying passenger, or who shall have been fatally injured thereby, should death result within one calendar month after such accident. **Provided** that the person so killed or injured had upon his or her person, or had left at home this coupon, with his or her usual signature, written prior to the accident, in the space provided below, which, together with the giving of notice within seven days to the above Corporation is the essence of this contract.

This Insurance only applies to persons over 14 and under 65 years of age, is subject to the conditions stated above and contained in the General Accident Fire and Life Assurance Corporation Act, 1907, and holds good for the current month of issue only.

No person can recover under more than one Coupon Ticket in respect of the same risk.

Signature .....

This Coupon must not be cut out but left intact in THE ILLUMINATING ENGINEER as that being dated, forms the only evidence of its currency

MINISTRY OF MUNITIONS.

CALCIUM CARBIDE ORDER.

An Order issued by the Ministry of Munitions states that from Sept. 24th onwards all calcium carbide in the United Kingdom, except stocks not exceeding half a cwt., will be taken possession of by the Ministry.

During the first seven days of each month, commencing with October, 1917, all persons must furnish to the Controller of Non-Ferrous Materials Supply, AM2/H, Hotel Victoria, Northumberland Avenue, London, W.C.2, monthly returns of :—

(A) All calcium carbide held by them on the last day of the preceding month.

(B) All calcium carbide purchased or sold by them for future delivery and not yet delivered on such last day.

(C) All calcium carbide delivered to them during the preceding month.

No return is required from persons whose total stock of calcium carbide in hand and for future delivery does not exceed half a cwt.

SCIENCE AND TRADE.

Dr. Addison, Minister of Reconstruction, when addressing the annual conference of the Library Association on Oct. 3rd, spoke with special approval of the movement for the creation of additional technical and commercial libraries adapted to the need of each locality. In order to pay for the war the different trades would have to throw their heart and soul into the dissemination of useful and necessary information.

A close working relation between our higher educational organisations and the business community was absolutely essential for our future industrial progress. In any scheme for promoting technical research and information he hoped the libraries would take an important share.

GAS MANTLE LIGHTING CONDITIONS IN TEN CITIES IN THE UNITED STATES.

A technologic paper (No. 99) issued by the Bureau of Standards Washington, and summarised in the Journal of the Franklin Institute for September, gives the results of a careful inspection of about 4500 gas lamps in service in ten of the largest cities in the United States. The condition of mantles, glassware pilot-light and other particulars are noted in order to determine to what extent the consumer benefited through periodical maintenance service.

According to these observations a lamp not on regular maintenance service is likely to be defective $5\frac{1}{2}$ times as often as one which is regularly maintained. Also, on the average, one in three of the lamps on regular maintenance was not in good condition, whereas the defects noted in the lamps not so maintained average more than one for every lamp.

The principal defects in the maintenance systems were also investigated, and one satisfactory system of estimating the expenses for maintenance work, together with a set of unit costs, is presented based on the analysis of the operation of ten gas companies. A suggested table of costs for each type of unit is given.

SAFETY AND GAS LIGHTING.

A recent issue of the *Gas Institute News* refers to the appointment of a Committee on Automatic Gas Shut-offs by the American Gas Institute. The question is being debated whether it is desired to provide an arrangement so that the gas may be automatically shut off in the event of a fire but there is evidently difference of opinion on the subject. A letter has been addressed to Mr. W. H. Merrill, President of the Underwriters Laboratories, Chicago, pointing out that the risk is too insignificant to make such a step desirable.

Quotation is also made from a recent letter from Dr. Stratton, Director of the Bureau of Standards, referring to the value of gas lighting for emergency purposes ; in the event of a fire the gas can be cut off by the police or fire brigade, and interruption of the service rarely occurs until this is done.

THEATRE LIGHTING WITHOUT FOOTLIGHTS.

According to the *Scientific American*, a large theatre in Philadelphia is to be lighted entirely from above, and without footlights. The light will be received from a number of lamps, totalling over 100,000 candle-power, manipulated from a steel bridge above the proscenium arch.

The arrangement is said to enable great flexibility in the direction and distribution of light to be obtained, but it would be interesting to know how the requisite shadow conditions can be secured without any illumination from the front.